

## WHAT IS CLAIMED IS:

1. An image processing apparatus for quantizing multilevel color image data containing at least two kinds of color components, comprising:
  - 5 error addition means for adding a quantization error value distributed from a neighboring pixel for each color component to each of a plurality of color components contained in a target pixel;
  - a threshold table which stores a quantization threshold for each of the color components in accordance with a combination of color component values of pixels;
  - 10 modulation amount determination means for determining a threshold modulation amount of each color in accordance with a combination of color component values of pixels including the target pixel; and
  - 15 quantization means for acquiring a threshold for each color component from said threshold table in accordance with a combination of color components of the target pixel, determining a threshold modulated by adding the modulation amount to the threshold for each color, and quantizing the target pixel in accordance with a relationship in magnitude between the modulated threshold and a value of each color component to which an error value is added by said error addition means.
  - 20 2. The apparatus according to claim 1, wherein said modulation amount determination means determines a

threshold modulation amount for each color in accordance with a combination of color component values of the target pixel.

3. The apparatus according to claim 1, wherein said 5 modulation amount determination means determines a threshold modulation amount for each color in accordance with a combination of average values, maximum values, or minimum values of color components of the target pixel and a neighboring pixel thereof.

10 4. An image processing apparatus for quantizing multilevel color image data containing at least two kinds of color components, comprising:

error addition means for adding a quantization error value distributed from a neighboring pixel for 15 each color component to each of a plurality of color components contained in a target pixel;

quantization means for quantizing each color component of the target pixel; and

20 a diffusion coefficient table which stores a diffusion coefficient for diffusing a quantization error produced by said quantization means, in accordance with a combination of color component values of a pixel,

25 wherein said error addition means adds an error value to the target pixel in accordance with a combination of color components of the target pixel and a diffusion coefficient selected from said diffusion

coefficient table.

5. The apparatus according to claim 4, wherein said  
error addition means selects a diffusion coefficient  
from said diffusion coefficient table in accordance  
5 with a combination of color component values of the  
target pixel.

6. The apparatus according to claim 4, wherein said  
error addition means selects a diffusion coefficient  
from said diffusion coefficient table in accordance  
10 with a combination of average values, maximum values,  
or minimum values of color components of the target  
pixel and a neighboring pixel thereof.

7. The apparatus according to claim 4, wherein said  
error addition means selects a diffusion coefficient  
15 from said diffusion coefficient table in accordance  
with a product of color component values of the target  
pixel and a neighboring pixel thereof.

8. An image processing apparatus for quantizing  
multilevel color image data containing at least two  
20 kinds of color components, comprising:

error addition means for adding a quantization  
error value distributed from a neighboring pixel for  
each color component to each of a plurality of color  
components contained in a target pixel;

25 a threshold table which stores a quantization  
threshold for each of the color components in  
accordance with a combination of color component values

of pixels;

modulation amount determination means for determining a threshold modulation amount of each color in accordance with a combination of color component 5 values of pixels including the target pixel;

quantization means for acquiring a threshold for each color component from said threshold table in accordance with a combination of color components of the target pixel, determining a threshold modulated by 10 adding the modulation amount to the threshold for each color, and quantizing the target pixel in accordance with a relationship in magnitude between the modulated threshold and a value of each color component to which an error value is added by said error addition means;

15 and

a diffusion coefficient table which stores a diffusion coefficient for diffusing a quantization error produced by said quantization means, in accordance with a combination of color component values 20 of a pixel,

wherein said error addition means adds an error value to the target pixel in accordance with a combination of color components of the target pixel and a diffusion coefficient selected from said diffusion 25 coefficient table.

9. An image processing apparatus for quantizing multilevel color image data containing at least three

kinds of color components, wherein  
a combination of two kinds of color components is  
quantized by an image processing apparatus defined in  
claim 1, and

5 a remaining color component is quantized by the  
image processing apparatus defined in claim 1 with a  
value of a color component other than a target color  
component being regarded as 0.

10. An image processing method of quantizing  
10 multilevel color image data containing at least two  
kinds of color components, comprising:

an error addition step of adding a quantization  
error value distributed from a neighboring pixel for  
each color component to each of a plurality of color  
15 components contained in a target pixel;

a modulation amount determination step of  
determining a threshold modulation amount of each color  
in accordance with a combination of color component  
values of pixels including the target pixel; and

20 a quantization step of acquiring a threshold for  
each color component, in accordance with a combination  
of color components of the target pixel, from a  
threshold table which stores a quantization threshold  
for each of the color components in accordance with a  
25 combination of color component values of pixels,  
determining a threshold modulated by adding the  
modulation amount to the threshold for each color, and

quantizing the target pixel in accordance with a relationship in magnitude between the modulated threshold and a value of each color component to which an error value is added in the error addition step.

5 11. The method according to claim 10, wherein in the modulation amount determination step, a threshold modulation amount for each color is determined in accordance with a combination of color component values of the target pixel.

10 12. The method according to claim 10, wherein in the modulation amount determination step, a threshold modulation amount for each color is determined in accordance with a combination of average values, maximum values, or minimum values of color components 15 of the target pixel and a neighboring pixel thereof.

13. An image processing method of quantizing multilevel color image data containing at least two kinds of color components, comprising:

20 an error addition step of adding a quantization error value distributed from a neighboring pixel for each color component to each of a plurality of color components contained in a target pixel; and

a quantization step of quantizing each color component of the target pixel

25 wherein in the error addition step, an error value is added to the target pixel in accordance with a combination of color components of the target pixel and

a diffusion coefficient selected from a diffusion coefficient table which stores a diffusion coefficient for diffusing a quantization error produced in the quantization step, in accordance with a combination of 5 color component values of a pixel.

14. The method according to claim 13, wherein in the error addition step, a diffusion coefficient is selected from the diffusion coefficient table in accordance with a combination of color component values 10 of the target pixel.

15. The method according to claim 13, wherein in the error addition step, a diffusion coefficient is selected from the diffusion coefficient table in accordance with a combination of average values, 15 maximum values, or minimum values of color components of the target pixel and a neighboring pixel thereof.

16. The method according to claim 13, wherein in the error addition step, a diffusion coefficient is selected from the diffusion coefficient table in accordance with a product of color component values of 20 the target pixel and a neighboring pixel thereof.

17. An image processing method of quantizing multilevel color image data containing at least two kinds of color components, comprising:  
25 an error addition step of adding a quantization error value distributed from a neighboring pixel for each color component to each of a plurality of color

components contained in a target pixel;

          a modulation amount determination step of determining a threshold modulation amount of each color in accordance with a combination of color component

5    values of pixels including the target pixel; and

          a quantization step of acquiring a threshold for each color component, in accordance with a combination of color components of the target pixel, from a threshold table which stores a quantization threshold

10    for each of the color components, in accordance with a combination of color component values of pixels,

          determining a threshold modulated by adding the modulation amount to the threshold for each color, and quantizing the target pixel in accordance with a

15    relationship in magnitude between the modulated threshold and a value of each color component to which an error value is added in the error addition step

          wherein in the error addition step, an error value is added to the target pixel in accordance with a

20    combination of color components of the target pixel and a diffusion coefficient selected from a diffusion coefficient table which stores a diffusion coefficient for diffusing a quantization error produced in the quantization step in accordance with a combination of

25    color component values of a pixel.

18. An image processing method of quantizing multilevel color image data containing at least three

kinds of color components, wherein

a combination of two kinds of color components is quantized by an image processing method defined in claim 10, and

5 a remaining color component is quantized by the image processing method defined in claim 10 with a value of a color component other than a target color component being regarded as 0.

19. An image processing apparatus for performing  
10 error diffusion processing for multilevel image data constituted by at least two kinds of density components and outputting a result of the error diffusion processing,

wherein at least one of setting, holding, and  
15 using of parameters with respect to an N-dimensional color space is performed on the basis of N kinds of input colors.

20. An image processing apparatus for performing error diffusion processing for multilevel image data  
20 constituted by at least two kinds of density components and outputting a result of the error diffusion processing,

wherein a composite color signal is acquired by predetermined means on the basis of N kinds of input  
25 colors, and parameters are set, held, or used on the basis of the composite color signal.

21. An image processing apparatus for performing

error diffusion processing for multilevel image data constituted by at least two kinds of density components and outputting a result of the error diffusion processing,

5       wherein at least one of setting, holding, and using of parameters is performed as an N-dimensional array with respect to an N-dimensional color space based on N kinds of input colors.

22.   An image processing apparatus including at least 10 one of a threshold, a threshold modulation amount, a density value modulation amount, and an error diffusion coefficient as a parameter in an image processing apparatus defined in claim 1.

23.   The apparatus according to claim 20, wherein at 15 least one of a composite value, a maximum value, a minimum value, and a product is used as the predetermined means.

24.   The apparatus according to claim 23, wherein the predetermined means is applied to at least two input 20 colors obtained from at least one pixel of a target pixel and a neighboring pixel thereof.

25.   An image processing apparatus for performing 25 error diffusion processing for multilevel image data constituted by at least two kinds of density colors with respect to N kinds of colors, outputting a result of the error diffusion processing, and at the same time, independently performing error diffusion processing

with respect to other several colors,

wherein at least one of setting, holding, and using of parameters is performed for an N-dimensional color space with respect to the N kinds of colors on 5 the basis of N kinds of input colors, and some of the parameters set for the N kinds of colors are used with respect to said other several colors.

26. The apparatus according to claim 1, wherein the plurality of color components comprise cyan and magenta 10 components.

27. A computer program product for causing a computer to quantize multilevel color image data containing at least two kinds of color components, comprising:

15 a code for an error addition step of adding a quantization error value distributed from a neighboring pixel for each color component to each of a plurality of color components contained in a target pixel;

20 a code for a modulation amount determination step of determining a threshold modulation amount of each color in accordance with a combination of color component values of pixels including the target pixel; and

25 a code for a quantization step of acquiring a threshold for each color component from a threshold table in accordance with a combination of color components of the target pixel, determining a threshold modulated by adding the modulation amount to the

threshold for each color, and quantizing the target pixel in accordance with a relationship in magnitude between the modulated threshold and a value of each color component to which an error value is added in the 5 error addition step.

28. The product according to claim 27, wherein in the modulation amount determination step, a threshold modulation amount for each color is determined in accordance with a combination of color component values 10 of the target pixel.

29. The product according to claim 27, wherein in the modulation amount determination step, a threshold modulation amount for each color is determined in accordance with a combination of average values, 15 maximum values, or minimum values of color components of the target pixel and a neighboring pixel thereof.

30. A computer program product for causing a computer to quantize multilevel color image data containing at least two kinds of color components, comprising:

20 a code for an error addition step of adding a quantization error value distributed from a neighboring pixel for each color component to each of a plurality of color components contained in a target pixel;

25 a code for a quantization step of quantizing each color component of the target pixel; and  
a diffusion coefficient table  
wherein in the code for the error addition step,

a diffusion coefficient is selected, in accordance with a combination of color components of the target pixel, from a diffusion coefficient table which stores a diffusion coefficient for diffusing the quantization

5 error in accordance with a combination of color component values of a pixel, and an error value is added to the target pixel in accordance with the selected diffusion coefficient.

31. The product according to claim 30, wherein in the

10 error addition step, a diffusion coefficient is selected from the diffusion coefficient table in accordance with a combination of color component values of the target pixel.

32. The product according to claim 30, wherein in the

15 error addition step, a diffusion coefficient is selected from the diffusion coefficient table in accordance with a combination of average values, maximum values, or minimum values of color components of the target pixel and a neighboring pixel thereof.

20 33. The product according to claim 30, wherein in the error addition step, a diffusion coefficient is selected from the diffusion coefficient table in accordance with a product of color component values of the target pixel and a neighboring pixel thereof.

25 34. A computer program product for causing a computer to quantize multilevel color image data containing at least two kinds of color components, comprising:

a code for an error addition step of adding a quantization error value distributed from a neighboring pixel for each color component to each of a plurality of color components contained in a target pixel;

5                  a code for a modulation amount determination step of determining a threshold modulation amount of each color in accordance with a combination of color component values of pixels including the target pixel;

                  and

10                a code for a quantization step of acquiring a threshold for each color component, in accordance with a combination of color components of the target pixel, from a threshold table which stores a quantization threshold for each of the color components in accordance with a combination of color component values of pixels, determining a threshold modulated by adding the modulation amount to the threshold for each color, and quantizing the target pixel in accordance with a relationship in magnitude between the modulated

15                threshold and a value of each color component to which an error value is added in the error addition step

                  wherein in the code for the error addition step, a diffusion coefficient is selected, in accordance with a combination of color components of the target pixel,

20                from a diffusion coefficient table which stores a diffusion coefficient for diffusing a quantization error in accordance with a combination of color

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component values of a pixel, and an error value is added to the target pixel in accordance with the selected diffusion coefficient.